The CRUSHED STONE JOURNAL

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Detroit Is Chosen for Sixteenth Annual Convention

Report of the Research Advisory Committee to the Board of Directors

Airport Pavement Requirements

Cement-Penetration Road Practice in Australia

July-August • 1932

Official Publication
NATIONAL CRUSHED STONE ASSOCIATION

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Mohawk Limestone Products Company	Jordanville, N. Y.
Mohawk Limestone Products Company	Mount Vision, N. Y.
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General Crushed Stone Company	North LeRoy, N. Y.
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Lake Erie Limestone Company	Lowellville, Ohio
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Coast Quarries	Vancouver, B. C.
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Thomas Langton Crushed Stone	Collwater, Ont.
LaCle A. Desrosiers, Ltd.	Montreal, Que.
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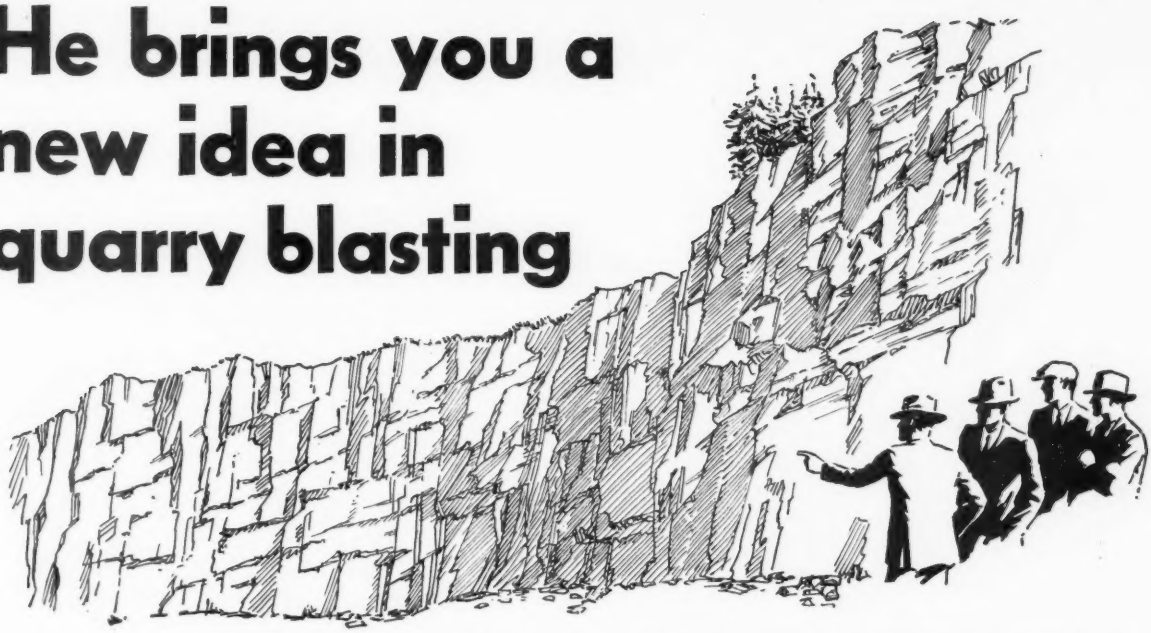

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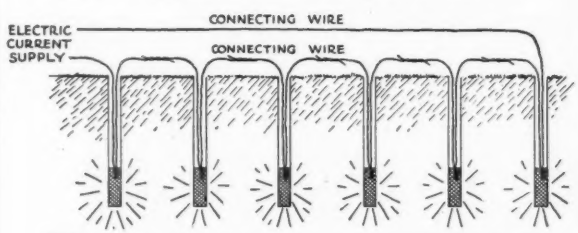

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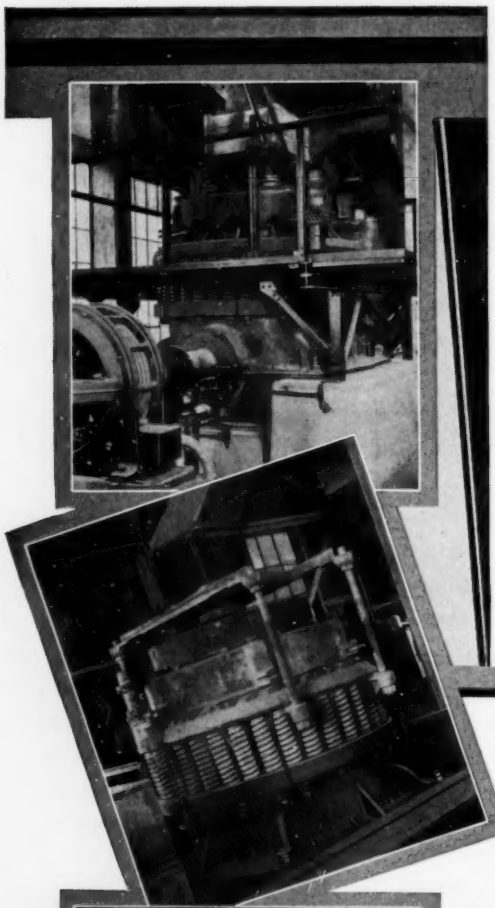

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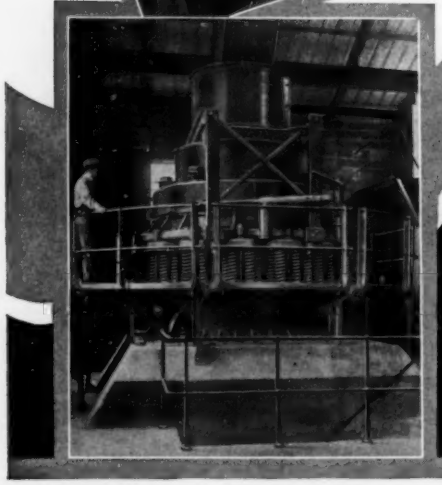

SYMONS CONE CRUSHERS

The Crushed Stone Journal

Official Publication of the NATIONAL CRUSHED STONE ASSOCIATION

J. R. BOYD, Editor

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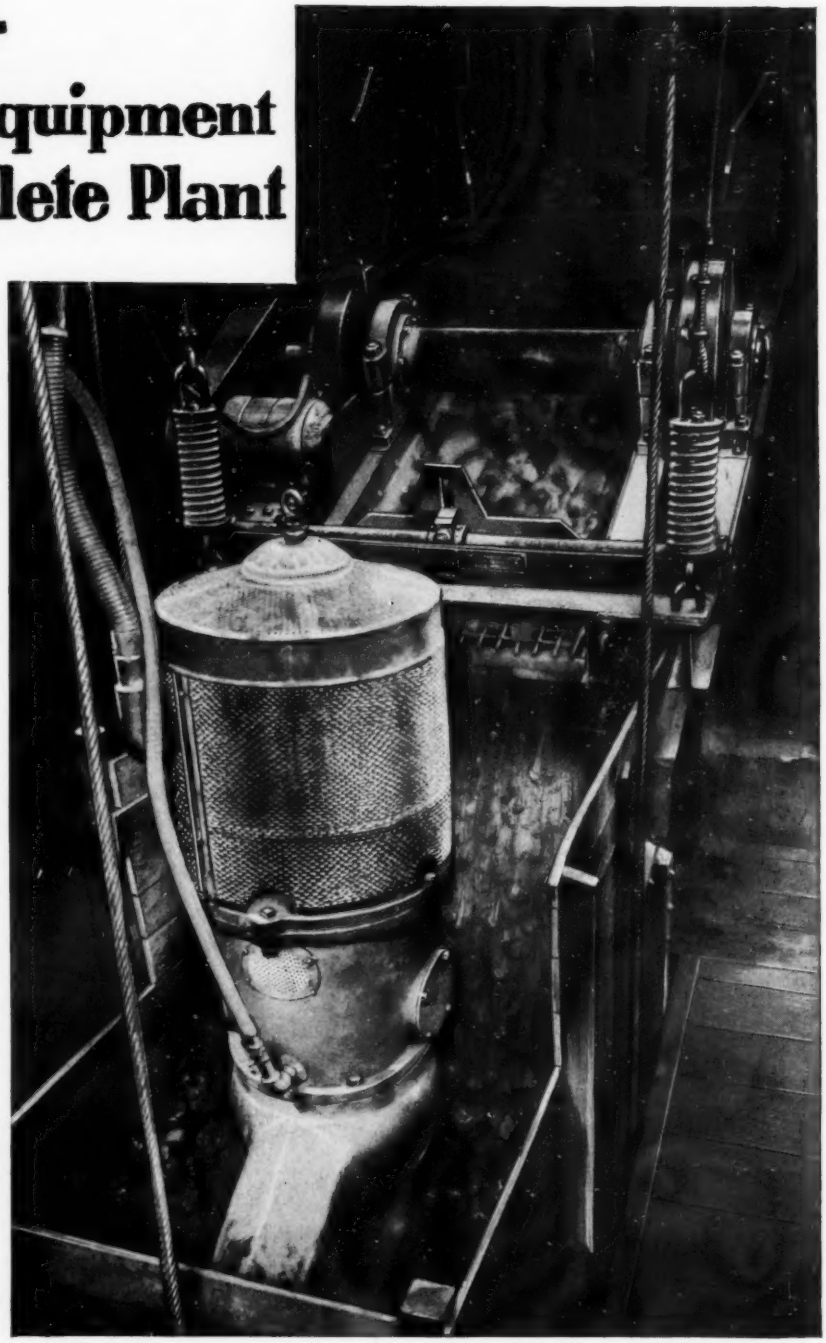

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THE
CRUSHED STONE JOURNAL
WASHINGTON, D. C.
Vol. VIII No. 5 JULY-AUGUST, 1932

Detroit is Chosen for Sixteenth Annual Convention

◆ N. C. S. A. will participate in Highway and Building Congress. Crushed stone and sand and gravel associations to hold joint exposition.

AT THE mid-summer meeting of the Board of Directors held at the Ambassador Hotel, Atlantic City, on July 15 and 16, it was unanimously determined to hold the Sixteenth Annual Convention of the National Crushed Stone Association at the Book-Cadillac Hotel, Detroit, Michigan. Excellent reasons motivated the Board in coming to this decision. Those who were fortunately present at the highly successful convention of the Association held at the Book-Cadillac Hotel in 1927 will recall the exceptional convention facilities offered by this hostelry. The Board also recognized that under present conditions the selection of a centrally located city was imperative and Detroit certainly meets this requirement, as by far the large majority of our membership will be able to reach Detroit with little if any more than an over-night journey. Since the holding of our convention in the Book-Cadillac in 1927 the management of this hotel has completely changed. It is now operated under the general direction of Ralph Hitz, who has made such a notable success of the New Yorker Hotel in New York City, where we have been privileged for the last few years to hold our annual Manufacturers' Division dinner meeting. The resident manager of the Book-Cadillac is Mr. E. T. Lawless, formerly of the Ambassador Hotel in Atlantic City, where our semi-annual Board of Directors' meetings are held and also lately of the New Yorker Hotel, New York City. Both of these gentlemen, because of previous contacts with our organization, are entirely familiar with our needs. We are assured, therefore, of the sympathetic cooperation in the handling of convention activities which is so necessary on the part of the hotel management if we are to have a smooth-running and efficiently conducted annual meeting.

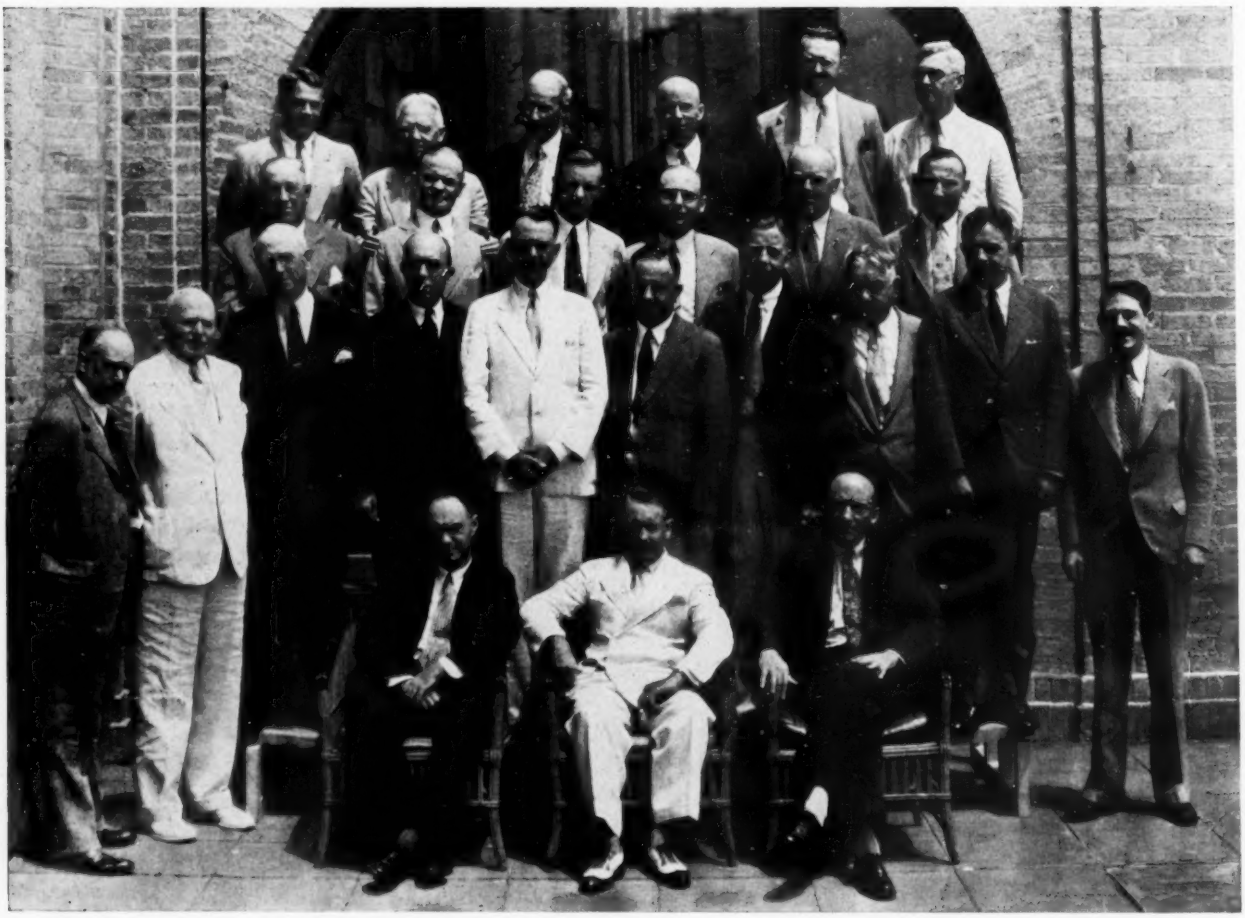
The decision, reached earlier in the year, for the sand and gravel and crushed stone associations to hold a joint manufacturers' exposition and the further move to bring all organizations interested in the highway and building field together in a gigantic congress were likewise most important considerations in determining upon Detroit. But perhaps we are getting a little ahead of our story.

Reactions following the Pittsburgh Convention as regards the Manufacturers' Division Exposition crystallized in two very definite directions. In order that the manufacturers might derive the greatest possible benefit from the exposition it was strongly urged that at future conventions the exposition be located, if at all possible, on the same floor with other convention activities. Further, in view of the necessity almost universally imposed upon members of the Division to curtail to a minimum the expense incident to participation in our annual convention and exposition, it was brought out that a helpful step would be the consolidation of the expositions of the Manufacturers' Divisions of the crushed stone and sand and gravel associations. Since the inception of the Manufacturers' Division its relationships with the National Association have been characterized by the spirit of friendliness and cooperation which has been largely responsible for the rapid growth and great success of the exposition as a feature of the annual convention. Those in authority in both associations recognized the unparalleled conditions which prompted such a suggestion and felt that the matter should be given very careful consideration. Consequently a special joint meeting of the executive committees of the two national associations was called for April 1 in New York City. This joint meeting had

hardly gotten under way when the obstacles confronting such a plan seemed almost insurmountable. In the first place a joint exposition called for simultaneous conventions in the same city. It was felt by both associations that it would be desirable for the conventions to be held in separate hotels. This immediately brought up the question as to the location of the exposition. Should it be held in the hotel with the sand and gravel convention or should it be held in the hotel with the crushed stone convention? An answer mutually acceptable to both groups seemed impossible. The next consideration was the possible holding of the two conventions simultaneously in the same hotel with a joint exposition under the same roof. The convention facilities of the Book-Cadillac Hotel seemed to lend themselves most effectively to such a plan and consequently the secretaries of the two associations were instructed to visit Detroit at the earliest possible date to determine on the ground whether such a plan was feasible. Messrs. Ahearn and Boyd, after a thorough inspection of the Book-Cadillac's convention facilities, presented a joint report to a second special meeting of the two executive committees held in New York on April 22, in which they reported that the plan was workable and recommended its adoption.

It was recognized from the first by both executive committees that in order to successfully execute such a plan real sacrifices would have to be made by both associations. The greater part of a day was devoted to a most thorough analysis of the situation and a careful weighing of the advantages and disadvantages involved in such a program. The following resolution was finally adopted by the joint meeting, and no more convincing proof is needed of the desire and intention of these groups to do everything reasonably within their power to cooperate with the manufacturers and to submerge their individual interests to those of the common good.

"It is the sense of the Executive Committees of the National Crushed Stone Association, the National Sand and Gravel Association, and the National Ready Mixed Concrete Association, assembled in joint meeting on Friday, April 22, 1932, in the Hotel New Yorker in New York City, that it be recommended to the respective Boards of Directors of the three associations that their 1933 conventions be held in the Book-Cadillac Hotel in Detroit, Michigan, in the week beginning Monday, January 16; each convention to be held independently of each other but



Among those present at the Board of Directors Meeting, Ambassador Hotel, Atlantic City, July 15 and 16

coincidentally as to time and place, under the general direction of a joint committee consisting of the president and secretary of each association; and it is further recommended that all activities on Thursday of the week of January 16 be devoted to a congress of the construction industry, to be under the supervision of the same committee, with the addition of Mr. Charles M. Upham as chairman of the committee for that day, together with the presidents and secretaries of such other associations as may join with us in the activities of that day."

This resolution, after a review of the circumstances leading up to its passage, was presented to the Board of Directors at its Atlantic City meeting and after comparatively little discussion it was decided "that our next annual convention shall be held on January 16, 17, 18 and 19, 1933, at the Book-Cadillac Hotel, Detroit, Michigan, in accord with the resolution passed by the joint meeting of the executive committees of the National Sand and Gravel Association and the National Crushed Stone Association and presented to the Board of Directors this morning."

Though detailed plans are just beginning to be formulated, a bird's-eye view of the set-up for Detroit will be of some interest at this time. The convention of the National Crushed Stone Association will open on Monday, January 16 and will run through Wednesday. The convention of the National Sand and Gravel Association will open on Tuesday, January 17 and run through Wednesday and the convention of the National Ready Mixed Concrete Association will be of one day's duration and will open on Wednesday morning. All of these meetings will be held simultaneously in the Book-Cadillac Hotel and concurrently with them will be the joint exposition of the Manufacturers' Divisions. Other major organizations interested in the highway and building field have indicated their intentions of holding their annual meetings in Detroit during the week of January 16. These various groups will combine on Thursday and Friday in a Highway and Building Congress, Thursday being devoted to the field of highway construction and Friday to that of building construction. More complete information regarding this Congress will be found on the editorial page of this issue.

In announcing Detroit as the location for our sixteenth annual convention to be held next January, it seemed desirable to give in some detail the background leading up to this decision. We will now proceed to give a brief chronological description of the more important happenings which took place at the midsummer meeting of the Board of Directors. As an appropriate preface, appreciation should be extended to those members of the Board who were present for the real personal sacrifice which each of them must necessarily have made in order to participate in the Atlantic City meeting. Considering the trying conditions under which most of our members are now operating the attendance was noteworthy as can be seen from the list of those present given at the conclusion of this article.

Immediately following the opening of the meeting on Friday morning, President Worthen announced to the Board the death of two members of the Association which had occurred since the Pittsburgh convention and Mr. Graves presented the following resolutions in memory of Capt. John E. Weber, and Bradford D. Pierce, Jr.:

WHEREAS Captain John E. Weber died at his residence in St. Louis, Missouri, on February 13, 1932; and
WHEREAS Captain Weber had been identified with the crushed stone industry for thirty years exerting a benevolent and kindly influence in his business relationships; and
WHEREAS he had supported loyally, faithfully, and efficiently the National Crushed Stone Association for many years; and
WHEREAS the Board of Directors of the National Crushed Stone Association is keenly aware of the loss sustained by the industry in the passing of one whose integrity in his business dealings furnished an inspiring example of business ethics and conduct and of the loss to the National Crushed Stone Association of a faithful and intelligent friend and supporter, and of the loss to his host of friends of a lovable and genial character, gentle and friendly to all with whom he came in contact, and the loss to his mother, wife and daughters of one upon whom they depended with love and confidence; now be it
RESOLVED by the Board of Directors of the National Crushed Stone Association in meeting assembled at the Ambassador Hotel in Atlantic City, July 15, 1932, that the understanding sympathy of the Board, collectively, and each of its members individually, be extended to his bereaved family and that a copy of these Resolutions be spread upon the minutes and published in "THE CRUSHED STONE JOURNAL" and further that a copy be sent to his family with the sincerest and deepest expression of our heartfelt sympathy to the St. Louis Quarrymen's Association of which he was a loyal member, and to the Casper Stolle Quarry and Contracting Company, which he served so long and faithfully.

WHEREAS Bradford D. Pierce, Jr. died at his home in Bridgeport, Connecticut, on Monday morning, April 18. 1932; and
WHEREAS Mr. Pierce was actively identified with the crushed stone industry for nearly forty years, during that time the influence of his personality, character and business ability being felt in territories far beyond the one in which he actually conducted his business; and
WHEREAS he was one of the officers of the National Association serving continuously on its Board of Directors until his retirement from an active interest in the crushed stone industry and for many years serving on the Executive Committee; and
WHEREAS the Board of Directors of the National Crushed Stone Association is fully cognizant of the loss to the industry of a splendid example of business integrity, initiative, and vision, and of the loss to the National Crushed Stone Association of a loyal counsellor, an abiding friend and inspiring leader, and of the loss to each of those who had the good fortune to know him of a sincere and affectionate friend of lovable disposition and characteristics and of the loss to his family of a husband and father to whom is rightly given unstinted love and devotion; now be it
RESOLVED by the Board of Directors of the National Crushed Stone Association in meeting assembled at the Ambassador Hotel, Atlantic City, July 15, 1932, that the understanding sympathy of the Board, collectively, and each of its members individually, be extended to his bereaved family and that a copy of these Resolutions be spread upon the minutes and published in "THE CRUSHED STONE JOURNAL" and further that a copy be sent to his family with the sincerest and deepest expression of our heartfelt sympathy.

These resolutions were adopted unanimously by a silent rising vote.

Progress Report of Officers and Committee Chairmen Approved

Detailed reports of the activities of the Association for the first six months of this year were presented by the President, Treasurer, Director of the Bureau of Engineering and the Secretary, as well as by the Chairman of the Research Advisory Committee. Brief verbal reports were also made by the Chairmen of the Association's various standing committees.

President Worthen in his remarks stressed the accomplishments of the Association over the past fourteen years and called attention to the many things the Association can do which can not be done by members individually. He laid emphasis on the responsibilities of the Board of Directors and expressed his faith in its loyalty and earnest desire to continue to administer the affairs of the Association in a manner such as will guarantee the most effective service to the membership.

The Director of the Bureau of Engineering reviewed the accomplishments of his department during the first six months of this year in considerable detail. The outstanding accomplishments of the research laboratory, not only during the first half of this year but also since its inception, were briefly covered in the report of the Chairman of the Research Advisory Committee and because of the belief that this report will be of special interest to the membership it is printed elsewhere in this issue in its entirety.

A detailed analysis of the financial condition of the Association was submitted by the Treasurer and Secretary, complete reports being given on the general fund, the special research fund, the laboratory fund and the Pittsburgh convention fund. One of the matters of very serious concern to the Board of Directors was the decreased income to the Association because of the present economic situation and to balance the budget without crippling the effectiveness of the work now being done by the Association was one of the real problems to come before the meeting. It was the concensus of opinion of the Board that it would be extremely undesirable to further curtail the work of the Bureau of Engineering, particularly with reference to investigations under way in the research laboratory, as to do so would seriously lessen the effectiveness of such work. The problem of adequately financing the Association has been with us before but in all fairness it should be said that it has never before been tackled with such earnestness of purpose as was evidenced at this meeting of the Board. At a special meeting of the Executive Committee held on Thursday evening preceding the Board meeting on Friday, a tentative budget of expense for the second six months was submitted. It was the opinion of the Executive Committee that even though serious reductions had been made in preparing this tentative budget further curtailment was necessary. After a discussion which lasted many hours a revised budget was prepared and submitted to the Board of Directors the following day. With comparatively little discussion this budget was approved by the Board on the basis that it represented the minimum of expense under which the Association could be operated during the second six months without a further curtailment which was not to be countenanced. By such action the Board reaffirmed its belief in the work of the Association and in the urgent necessity of continuing our present program of research investigations.

In the Secretary's report attention was directed to the attitude of the present Administration in regard to highways. Various legislation was cited which would be inimical to construction interests. The Secretary briefly outlined the activities of the National Committee for Trade Recovery and the recently organized Highway Users Conference.

Short informal reports were made by Mr. Hilliard, Chairman of the Committee on Uniform Cost Accounting and by Mr. Graves, Chairman of the Interpretation Committee, Trade Practice Rules, after which the meeting adjourned at 12 o'clock on Saturday, July 16.

The following is a list of the members of the Board of Directors and others who were present:

A. L. Worthen, W. M. Andrews, L. J. Boxley, F. O. Earnshaw, O. M. Graves, F. T. Gucker, W. E. Hilliard, A. S. Lane, Thos. McCroskey, B. A. McKinney, John Prince, Russell Rarey, John Rice, J. A. Rigg, F. W. Schmidt, Jr., T. I. Weston, Abe Goldberg, L. W. Shugg.

Others present:

J. Barab, Edw. M. Buck, J. R. Boyd, A. T. Goldbeck, A. W. Randle, P. B. Reinhold, Howard Rigg, N. C. Rockwood and Harold Williams.

Stephens-Adamson Mfg. Co., Ltd. To Handle "Saco-Orton" Line

The Stephens-Adamson Mfg. Co. of Canada, Limited, conveyor manufacturers at Belleville, Ontario, have concluded an arrangement with the Orton Crane and Shovel Company of Huntington, Indiana, for the manufacture and exclusive sale in Canada of Orton locomotive cranes, dipper shovels, pull back ditchers, skimmers, clamshell buckets, orange peel buckets, traveling gantry and cantilever cranes and similar equipment. This equipment will be known as the "Saco-Orton" line.

Orton equipment is widely known throughout the Dominion and the Orton Company feels that Canadian users can best be served by having their equipment made and serviced by a Canadian manufacturing and engineering firm.

The Stephens-Adamson factory is located at Belleville, Ontario, on both the Canadian National and Canadian Pacific railroads. Sales and engineering offices are located at 926 Bank of Hamilton Building, Toronto, and 220 New Birks Building, Montreal, with sales representatives in the principal cities of other provinces.

Report of the Research Advisory Committee to the Board of Directors[1]

By PAUL B. REINHOLD
Chairman

SINCE the beginning of 1932 your Research Advisory Committee has held three meetings as follows: Pittsburgh, January 19; New York City, March 31; and Atlantic City, July 14. These meetings were fairly well attended and much interest was displayed by the members in the activities of the Committee.

It is not my purpose to review in detail the work which the Committee has accomplished but, rather, merely to point out some of these accomplishments, indicate our aims and finally to emphasize with you the necessity for our Association and the industry to continue its support of our investigational activities.

Accomplishments of the Committee

As you are aware, the Committee is organized into groups, or sub-committees, dealing with some particular use of crushed stone or some phase of the stone industry. It is the purpose of these sub-committees to become the principal fact-finding bodies of the Association with regard to the special subject to which they are assigned. They are in no sense technical committees but are gatherers of facts which may be helpful in promoting the sale of stone. For the purpose of record the names of the committees as they stand at the present time may be listed as follows:

1. Standardization of Sizes—A. S. Owens, Chairman.
2. Dust Elimination—John Rice, Jr., Chairman.
3. Railroad Ballast—F. T. Gucker, Chairman.
4. Publicity—F. O. Earnshaw, Chairman.
5. Airports—F. E. Swineford, Chairman.
6. Low Cost Roads—J. A. Rigg, Chairman.
7. Bituminous Macadam—C. A. Munson, Chairman.
8. Bituminous Concrete and Special Bituminous Mixes—B. P. Rex, Chairman.
9. Concrete Roads
10. Concrete Products and Miscellaneous Concrete Construction—John Prince, Chairman.
11. Concrete for Building Construction—E. J. McMahon, Chairman.
12. Concrete for Mass Construction, Dam Construction and Sub-Aqueous Construction—R. E. Fowle, Chairman.
13. Filtration and Sewage Plants—L. C. Bonnell, Chairman.
14. Cost of Wayside Quarry Stone and Public-Owned Stone Quarries.
15. Standardization of Specifications and Marking of Supplies and Equipment—John Rice, Jr., Chairman.
16. Stone Sand
17. Plant Inspection—John Rice, Jr., Chairman.

[1] Presented at the meeting of the Board of Directors, Ambassador Hotel, Atlantic City, July 15-16, 1932.

Some of these sub-committees have turned in excellent progress reports or have given excellent advice in connection with our research work. Among these may be noted the following:

Dust Elimination—John Rice, Jr.
Publicity—F. O. Earnshaw.
Airports—F. E. Swineford.
Low Cost Roads—J. A. Rigg.
Bituminous Macadam—C. A. Munson.
Bituminous Concrete and Special Bituminous Mixes—B. P. Rex.
Filtration and Sewage Plants—L. C. Bonnell.
Standardization of Specifications and Marking of Supplies and Equipment—John Rice, Jr.

Most of the reports are in the nature of progress reports and the material in them has not as yet been published but as additional material is gathered and assembled it should be of value to the industry in the future. It is the aim of your Research Advisory Committee to encourage the work of the sub-committees to the end that valuable information may be collected for the good of the entire industry. This is one of its principal functions in addition to advising in connection with the work of our research laboratory.

The Research Work of Our Laboratory

A report by the Director of the Bureau of Engineering covering the research work of our testing laboratory has been presented to the Research Advisory Committee. No one, in looking back over the work of our laboratory during the past year, can gainsay its extreme value to our industry. This work has been accomplished with an extremely small staff of three men. It has been pioneering work which, unlike much original research work has all been eminently successful. There has been no backing up to a fresh start but the work has been pushed forward to completion practically in the manner originally planned. Thus the cost of accomplishing the results has been extremely small.

Among the outstanding projects which may be mentioned are stability tests on railroad ballast. These tests brought out some extremely useful facts showing the exceptional stability of stone ballast. Our tests on stone sand were highly successful in establishing more clearly than ever before the most favorable gradations for this material depending upon the concrete proportions and, finally, perhaps the most successful accomplishment of the laboratory was the development of a means for investigating low cost bituminous road mixtures by the use of a small circular track. As far as is known this is the only apparatus which is really suit-

able for the investigation of low cost bituminous road mixes.

During the past two meetings of your Research Advisory Committee your Director of the Bureau of Engineering has reported the results of four separate investigations with this track which, one year ago, was merely discussed by the Committee as a possible means for investigations of this type. This fact illustrates the directness of approach of our Bureau of Engineering Research Laboratory to the problems of the industry. All four of the investigations reported are of value to either the industry as a whole or to some of its members.

At the annual convention in Pittsburgh, your Chairman of the Research Advisory Committee reported for the Committee its confidence in the extreme value of the Research work being done by our Bureau of Engineering for the good of the industry and the vital necessity of our members continuing to support this phase of our work. Too frequently we see only those features of this work which affect us directly and in an unmistakable and tangible manner. We are apt to entirely forget the so-called intangible results of this work which imperceptibly, but none the less actually, have been of great benefit to us all. Lest we forget, it will not be amiss to give you a partial list of the accomplishments of our research laboratory since its inauguration only four years ago. I leave it to you if this is not a list of which we, as an organization, might well feel proud.

Your Committee wishes to state its unqualified opinion that the research work of the Bureau of Engineering has in the past been of tremendous importance in helping our industry, and particularly has this been the case during the past year. Its work is practical, timely and valuable. Accordingly, we wish to recommend as strongly as possible that this phase of the work of the Association be not curtailed in the slightest and that steps be taken to continue its adequate support at least on the same scale as at present.

LIST OF ACCOMPLISHMENTS OF THE RESEARCH LABORATORY

National Crushed Stone Association, Inc.
November, 1928, to July, 1932.

1. It has determined the effect of gradation on the percentage of voids and has thus shown how to obtain a more favorable gradation.
2. It has demonstrated that stone dust is not necessarily harmful in stone used for concrete; thus rejections might be prevented or more favorable specifications drawn. Both of these results have actually occurred.
3. It has with different types of materials demonstrated the relative strength of stone and gravel concrete and has shown how to design concrete for a given beam strength.
4. It has developed a method for the design of concrete for any required beam strength and has emphasized the value of the beam test for highway construction.
5. It has investigated the effect of gradation on concrete strength and has demonstrated that a wide range in gradation does not result in a wide range in strength.
6. It has demonstrated the fallacy of the sodium sulfate soundness test which at one time was required as a mandatory test but which now is rapidly becoming used only as a danger signal.
7. It has demonstrated the usefulness of a freezing test for soundness to supplant the objectionable sodium sulfate soundness test.
8. It has shown why highways should be tested for beam strength and has pointed out the inaccuracies in design of many of the beam testing machines; thus the standardization of the beam test has been more rapidly accomplished.
9. It has, through investigations, pointed out ways for strengthening the edges of bituminous macadam roads.
10. It has shown that flat and elongated pieces are not as harmful in concrete as generally supposed; that poor gradation is more important than flat elongated pieces in making for lack of workability.
11. It has made laboratory tests which have led to the development of methods which really work for preventing segregation.
12. It has demonstrated that certain slag concretes have abnormally high expansion. This is borne out in practice and the facts developed should lead to fairer competition between stone and slag.
13. Many useful facts of value to the stone industry have been demonstrated as the result of freezing tests on mortars and concretes.
14. It has made important contributions to the literature on stone sand and has demonstrated the most favorable gradations to use for lean and rich concrete mixtures.
15. It has made an outstanding contribution to the testing of railroad ballast for stability; developing the apparatus and demonstrating the merit of crushed stone from the stability standpoint.
16. It has developed the only known laboratory means for testing low cost bituminous road mixtures making use of a small circular testing track.
17. It has, during the few months of operation of this track, developed some very strong indications regarding the influence of gradation and shape of aggregates on stability and durability of mixed-in-place bituminous mixtures.

Tiny Challenge

Clock people have a story that they tell about a jewelry concern in Indianapolis. The firm's engineering department had been experimenting with steel wire, drawing it out very fine. They finally produced a piece of 120-gauge wire—practically invisible. The boys were proud—so proud, in fact, that they cut off a strand and sent it to a rival jewelry concern in Switzerland. "Just to show you what we are doing in Indianapolis."

Weeks went by. A few weeks before Easter a package bearing a Swiss postmark arrived. The boys opened it with great care. Inside was a steel block; mounted on the block were two steel standards; strung between the standards was the same piece of 120-gauge wire. At one end of the block was mounted a small microscope delicately focused on a certain spot on the wire. One by one the engineers placed an eye to the microscope and examined in silence the work of their foreign rivals, who had bored, in the wire, a rather handsome little hole.—*From "Aglow with Friendliness."*

Airport Pavement Requirements[1]

By FRED E. SWINEFORD

Chief Engineer, The Ohio Crushed Stone Association, Columbus, Ohio

◆ In view of the rapidly increasing volume of airport construction this field would seem to offer an attractive market for crushed stone. The following article should prove distinctly helpful.

Commercial air transportation has developed during the past ten years to such magnitude that both cities and private companies have found it necessary to provide adequate ground and terminal facilities for aircraft. Consequently over 1,500 airports have been established throughout the United States. One of the ground facilities needed where year-round daily air traffic is maintained is uniform surfaced runways with adequate drainage and markings. The ideal runway is one which is sufficiently resilient and skid-proof for landing and yet smooth and hard enough for quick take off. The absence of adequate surfacing and drainage has, in numerous instances, been responsible for accidents to airplanes taking off and landing with resulting injury and even loss of life and costly delays to air transport operations.

The Aeronautics branch of the Department of Commerce, with the cooperation of the American Engineering Council and the American Road Builders' Association, has just completed a report on airport drainage and surfacing. For a year and a half this group has been compiling information from over 100 well known airports throughout the United States. This report is the latest text on drainage and surfacing of airports. It gives the ideal requirements for airport landing areas. It explains how these requirements have been met in a practical way. Extracts and recommendations from this report along with personal observations by the author of 30 outstanding airports from coast to coast have furnished the greater part of the data for this paper.

The character of traffic on airport pavements is reasonably well known. The gross weight of the heaviest transport airplanes in regular daily use in this country is approximately 24,000 pounds and at present there is only a limited number of these in operation. There is a larger number of the 18,000 pound class. The more numerous multi-motored transport airplanes in general use have a gross weight ranging from about 10,000 to 14,000 pounds. The load produced by impact of aircraft may vary from 1½ to 2½ times the static load. Impact, however, is frequently overestimated because the entire weight of an airplane is supported by the wings at the instant the wheels come upon the runway, and as the speed decreases the load gradually is transferred from the wings to the wheels. Heavy aircraft employed in transport use is very rarely landed improperly so as to cause bouncing and consequently impact. Furthermore, with the development of low pressure air wheels the load is well cushioned and uniformly distributed.

There is an important difference between the design requirements for highway and runway traffic. In the case of the highway, the wheels of one vehicle very closely follow the track of the preceding wheels, and the load is applied at very close intervals. As highway traffic usually moves in "traffic lanes," these loads are applied at the same point, one after another, resulting in a large amount of traffic being applied to the same limited area of the highway surface each day. With the airplane it is very different. The density of traffic per square yard of area on the busiest airport of the near future will doubtless be very limited compared to major thoroughfares. Airplanes seldom land twice in exactly the same spot; therefore an airport surface is not subject to as frequent applications of impact loads as is a highway.

Information obtained through an inspection of a large number of airports throughout the United States indicates that in many instances, airport surfaces are satisfactorily carrying the present limited volume of light airplane traffic which if subjected to a limited amount of heavy truck traffic would fail in a short time.

It seems to be the opinion of qualified observers that air transportation will continue to employ the conventional type of airplane in use today. There will be constant improvements, and refinements of construction details and operating methods, but it is felt that the transport airplane in use ten years from now will not differ greatly in basic design from present-day craft.

The action of the craft on airport pavements comes directly from the wheels, the tires, the tail skid, and the propeller blast. Whether the heavy airplane of the future will be equipped with more than three wheels is of interest from the standpoint of the distribution of the load to the landing field surface. Some designers are of the opinion that not more than three wheels will ever be used; others that four main landing wheels, placed two in tandem, will be the design; and some believe that there will be four main landing wheels of the duplex type.

It would seem, however, that the limit in maximum

[1] Presented at the Fifteenth Annual Convention of the National Crushed Stone Association, William Penn Hotel, Pittsburgh, Pa., January 19-22, 1932.

Table I—AIRPORT PAVEMENTS, DRAINS, AND MARKERS

(From the 1932 Annual Report of Sub-Committee No. 5 on Airports of the Research Advisory Committee, National Crushed Stone Association)

		Akron Municipal	Allegheny County	Bettis Field	Cleveland Municipal	Detroit Municipal	Port Columbus	Lunken	Lambert (St. Louis Municipal)	Parks	St. Huberts	Curtiss-Steinberg	United	Vandalia
RUNWAYS	Location	Akron, O.	Pittsburgh, Pa.	Pittsburgh, Pa.	Cleveland, O.	Detroit, Mich.	Columbus, O.	Cincinnati, O.	Robertson, Mo.	E. St. Louis, Mo.	Montreal, Canada	E. St. Louis, Mo.	Burbank, Cal.	Dayton, O.
	Sq. Yds. Runway Area	30,000	480,000	42,000	Turf field & 53,000 sq. yd. aprons.	117,000	90,000	13,400	130,000	74,000	91,000	54,000	300,000	16,500
	Type of Surface	Bituminous Macadam	Bituminous Macadam	Bituminous Macadam	Amiesite Aprons	Asphaltic Concrete	Asphalt	2-42′ strips of Bituminous Macadam with 16 ft. Concrete gutter in center	Macadam	Stone or Cinders	Bituminous Macadam	Reinforced Concrete	Asphaltic Mix	Bituminous Macadam
	Base Material	Bituminous Treated Soil	Crushed Slag Choked	Natural Soil	5″ Crushed Stone	5″ Black Base	5″ Concrete	3″ Macadam	Macadam	4″ of coarse stone or cinders	6″ gravel & 4″ W. B. Macadam	Cinders	2½″ Asphalt and Sand field mix	2″ limestone screenings & 4″ W. B. base
	Surface Material	Crushed Limestone	Crushed Slag	Crushed Slag	Amiesite	Asphaltic Concrete	Asphaltic Concrete	2″ Bituminous Macadam & 1″ chip seal	Stone chips	⅜″ stone or cinders	Crushed Limestone	Concrete	2½″ Sand & asphalt plant mix	Retread
	Binder Used	Tar and Asphalt	Tarmac	Tarmac	Asphalt	Asphalt	Asphalt	Asphalt Emulsion	Asphalt	None	Colas	Portland Cement	Asphalt	Tarvia
	Construction Method	Mixed-in-place 3½″ thick	Penetration & mixed-in-place 8″ total thickness	Penetration 5″ thick	Waterbound stone base & Amiesite Surface total 6½″	5″ Asphaltic Concrete base, 2″ Asphaltic Concrete top	1½″ AC open mix on 5″ Concrete base	6″ Macadam with penetration top 100′ wide drained to concrete gutter at center		4″ coarse stone or cinder base	6″ gravel—4″ limestone—3″ penetration top		2½″ field mix—2½″ plant mix	2″ stone Screenings 4″ W. B. course 2″ Bituminous retread
	Cost Sq. Yd.	$0.80	1.20	0.63	2.25		1.33	1.63	1.05			2.25		1.38
	Results Obtained	Excellent	Satisfactory	Satisfactory	Excellent	Satisfactory	Satisfactory	Good	Satisfactory	Satisfactory	Satisfactory	Satisfactory	Satisfactory	Satisfactory
	Pilots' Comments	Very good	Very satisfactory	Easy to land on	Favorable	Skid-proof	Very satisfactory	Very favorable	Satisfactory		Non-skid	Satisfactory	Satisfactory	Satisfactory
UNDERDRAINS	Length of Drain		10,000 Ft.	8,000 Ft.	1,000,000 Ft.			10,000 Ft.	528,000 Ft.	3,000 Ft.	12,000′ Tile 5,000′ Stone	250,000 Ft.		
	Type of Drain	Vitrified Pipe	French and Concrete flumes	French and Tile	French Drains		Tile	Concrete & Vitrified Pipe	8″ Vitrified Pipe	Vitrified Pipe	6″ Tile Crushed rock	Vitrified Tile		Tile
	Backfill Material	Crushed Limestone and Slag	Crushed Slag	Crushed Slag	Cinders			Rock, Gravel and Cinders	Macadam	Stone and earth		Crushed Stone		Crushed Stone
	Cost Lin. Ft.				$0.23			2.50 for 10″ to 54″		1.00				
	Results Obtained	Satisfactory	Satisfactory		Excellent			Favorable	Satisfactory	Satisfactory		Very good		
MARKERS	Type of Marker	200 ft. circle AKRON						100′ circle 7′ wide		100′ circle 7′ wide		Circle and name		
	Purpose of Marker	Center of landing area Identification						Center of landing area	To identify port	Center of landing area		To identify field		
	Material Used	Crushed limestone Whitewashed stone						Crushed stone	Macadam	⅜″ stone		Yellow paint		

*Total 1,490,900.

tire size will be reached as in truck and motor bus practice, and that loads exceeding certain limits will be distributed through additional wheels. Multiple wheel design for airplanes may present serious difficulties, but if airplanes of great size are to be produced, this difficulty must be overcome.

The kind of tires used is a factor relating not only to impact, but also to the distribution of the load upon the landing surface. Some are of the opinion that low pressure tires will come into general use on all types of airplanes. Others think that with improved shock absorbers even a higher pressure tire and smaller wheel will be used. Still others are of the opinion that the low pressure tire will not be used extensively on the larger planes unless the retractable landing gear comes into general use.

There seems to be general agreement as manifested in the opinion of airplane designers, that tail skids will in time be eliminated and estimates of the time required vary from one to three years, with two years as a general average. One of the leading manufacturers of both large and small planes reported that this year 80 per cent of his models will have tail wheels as standard equipment, and the other 20 per cent as optional equipment.

While a large percentage of the new airplanes are being equipped with tail wheels, the planes in present use are largely equipped with skids, and it is not likely that many of them will have tail wheels substituted for skids, unless it is made compulsory. While the substitution of the wheel for the skid is a comparatively simple matter in the case of airplanes already equipped with brakes, to add both tail wheel and brakes to an existing airplane is in many cases a major operation.

Some of the inexpensive light airplanes, because of the saving in manufacturing cost and the reduction in weight, will no doubt continue to use tail skids unless the airports take definite steps to preclude their use.

Runways that are not bound with some kind of cementitious material are objectionable largely because of the action of the propeller in picking up particles with consequent damage to the propeller itself and to the fabric covering of the airplane. This difficulty is most pronounced immediately before take-off and during the beginning of the run of a plane in taking off. It is during this period that damage is most likely to occur to fuselage, wing and tail surfaces, and to the propeller. After the plane gains momentum the danger from this source is not nearly so great, therefore some improvement of the ends of such runways would be most desirable. A suitable surface texture is necessary from the standpoint of safety, and by suitable design and careful construction a most satisfactory surface can be obtained.

On airport pavements, as well as on practically all other structures exposed to the elements, the deteriorations is caused, to a large extent, by the action of water from rainfall, heat from the sun, freezing and thawing. Too frequently these destructive forces are overlooked by engineers in the design of pavements, bridges, dams, and other exposed structures.

Runways, taxiways, aprons, and warming up platforms are most satisfactory when paved with some type of surface which is bound together in such a way that it is not disturbed by the aircraft or the elements. The best results are obtained from pavement which is rough enough to prevent skidding when wet and smooth enough and hard enough for quick take-offs. A resilient surface is highly desirable and may be obtained in bituminous surfaces. However, extreme resiliency can only be secured at the expense of an unstable surface.

The extent of airport pavements naturally depends upon the number of aircraft operating thereon. However, certain minimum requirements are set up as highly desirable for paved runways. The minimum width for paved runways should be at least 100 ft. Taxiways should be at least 50 ft. wide.

In general the transport type of airplane now in use lands at from 60 to 65 miles per hour. Considering the various conditions of temperature and weather encountered at airports on scheduled airlines and the fact that these planes should be operated with a margin of safety in landing and taking off, landing lengths at sea level of at least 2,500 feet are necessary and it is strongly recommended that they be not less than 3,500 feet. For example, an airplane in landing will many times, as a safety measure, be flown in to the airport at a speed well above stalling. The result is that a portion of the available landing strip is used for approach and the wheels may not touch the ground until one-third or more of the strip has been used. In order to provide for maximum safety of operation and also for probable future requirements as indicated by present trends in airplane design, it is believed that landing runs of 2,500 feet for this type of operation should be the absolute minimum. Where limited funds do not permit the building of the full length at the beginning of the development, the portions forming the hub of the runway system are frequently built first.

A master plan for the entire landing area should be developed before any grading, drainage or surfacing is undertaken. Even though only part of the area will at first be developed, a plan for the entire area is essential to the orderly development of the airport. Failure to prepare such a plan is almost certain to lead to costly mistakes which will become apparent as the landing area is further developed.

The preparation of a master plan is of importance not only in the construction of new airports but also for existing airports. Such a plan for an existing port will disclose its faults, and additional improvements can be made, utilizing as much of the original layout as appears advisable, with the assurance that the funds are being expended to the best advantage.

A plan for grading the entire landing area should be

developed even though only part of the area will be graded when the first improvements are made. The reason for this is evident, for any improvements of the surface, and any drainage installed, may be seriously affected by future developments involving any changes in grade.

In the same way a complete drainage plan should be designed, at least insofar as the main trunk system is concerned, in order that subsequent drainage work may be carried on without the waste and loss due to the possible necessity for changes in that part of the system previously installed.

Likewise, the construction of runways should not be undertaken without the assurance of their being placed on grades that are suitable and permanent. In some instances, where it is not feasible to grade the entire area at once, the grading for the runways and immediately adjacent areas can be accomplished in such a way as to obviate the possible necessity of having to change these grades later.

Runways must necessarily also be constructed at a low unit cost on account of their extensive area necessitated by their width, length, and several directions. The demands upon the airport runway are less severe than those upon the highway pavement. While the maximum loads are approximately the same on the runway as on the highway, there is far less concentration of traffic, less frequency of loads passing over and less severe impact. It is therefore logical to design runway pavements of a lesser thickness than is required for highways.

Runways are usually given a crown of about 4 to 6 inches per 100 feet of width. In an effort to improve the area adjacent to the runway, by reducing the amount of water that may flow upon it and in order to eliminate the surface intercepting drains, runways have in several instances been constructed with an inverted or negative crown. The reports indicate that where used this design has proven entirely satisfactory.

Before adopting a new type or method of surfacing that has not demonstrated its suitability under similar conditions of soil, climate and traffic, it would be well to construct only a limited amount and observe the results over a reasonable period of time before adopting it for use in a large way.

Considering pavements only, and classing runways improved with turf, soil admixtures of crushed stone, or gravel and bituminous treated natural soil, out of the pavement category, the types generally used are bituminous macadam, asphaltic concrete and Portland cement concrete. The average total thickness for these types is 6 inches. At the Akron Airport, 3½ inches of mixed-in-place bituminous pavement is giving satisfactory results. This was built directly upon the natural soil which had been given a surface treatment of bituminous material. Crushed stone was then spread, thoroughly coated with bituminous material, mixed and then rolled. Two bituminous seals were applied to thoroughly waterproof the surface and firmly hold the stone chips. The resulting surface is uniform, skidproof, and free from loose particles. This gives an example of very thin pavement giving satisfactory results. At St. Huberts Airport, near Montreal, a 3-inch bituminous macadam surface was built upon a 4-inch limestone course supported by a 6-inch gravel base. Total thickness there is 13 inches. Allegheny County airport at Pittsburgh has 100 acres of bituminous macadam on a crushed slag base with a total thickness of 8 inches. United Airport at Burbank, California, is paved with 300,000 sq. yds. of 2½ inch plant-mix asphaltic concrete on 2½ inches of field-mixed sand and asphalt. Port Columbus, Columbus, Ohio, and the Detroit Municipal Airport are both paved with 2-inch asphaltic concrete surface. At Columbus a 5 inch Portland cement concrete base was used and at Detroit a 5 inch asphaltic concrete base was used.

To prevent deterioration of bituminous surfaces from the lack of sufficient traffic, the following recommendations should be followed:

(1) Use a higher penetration bituminous material.
(2) Use a higher percentage of bituminous material in the mix.
(3) Reduce the amount of mineral filler.
(4) Thoroughly seal the surface with a heavy bituminous material.

The 1932 report of Sub-Committee No. 5 on Airports for the National Crushed Stone Association gives in detail the description of pavements at 13 prominent airports in North America (see Table I). This report states that in the 13 airports investigated there are 1,480,000 square yards of paved runways. Of this yardage 91 per cent is of the bituminous type. The average cost for 8 projects using this type is $1.28 per square yard.

With commercial aviation only 10 years old, airport pavements should be built with the possibility of extension in width, length, and thickness. An increased volume of air traffic may require longer and wider runways. Heavier craft may require greater thickness of pavement. In the selection of a surface, the possibility of adding to the original pavement in every dimension should be borne in mind.

Baldwin Appointed Hendrick Representative

R. F. Baldwin, who has represented Irving Iron Works, Long Island City, N. Y., in the Philadelphia territory for the past ten years, has been appointed Philadelphia district sales representative of Hendrick Manufacturing Company of Carbondale, Pa. Mr. Baldwin will handle the sale of Mitco Interlocked Steel Grating, Shur-Site Treads, Armorgrids and Hendrick Perforated Metal Grilles in Southeastern Pennsylvania, Southern New Jersey (including Trenton), and the states of Delaware and Virginia. He will continue to make his headquarters at 5813 North Fairhill Street, Philadelphia, telephone, Waverly 3147.

Cement-Penetration Road Practice in Australia[1]

By J. T. CAVANAGH
Civil Engineer, Sidney, Australia

◆ Recent experience has developed methods of grouting crushed stone in place, which produce a concrete of high strength and good surface at costs that can be borne by secondary roads.

CEMENT penetration is playing an important part in building the roads of Australia. Costs have been reduced by as much as five shillings per square yard below those of mixed concrete roads, and results that more than satisfy the demands of secondary-road construction have been obtained. The methods adopted differ somewhat from those in other countries and are indicated best by examples from actual practice.

Recent Practice

What may be regarded as normal cement-penetration practice was employed by H. Robinson, shire engineer of Sunshine, Victoria, on a street that carried a considerable amount of mixed heavy traffic and that originally was a 12-ft. macadam road about 3 in. thick on heavy basaltic clay foundations.

The old macadam was very lightly scarified and reshaped, and the clay shoulders were broomed down to meet the grade to a total width of 18 ft., 8-in. curbs being placed along each flank. About 8 in. of 2½-in. new stone was spread in two layers to templet and rolled to a uniform and even thickness of 7 in.

After the first layer of stone had been spread and rolled, the road was divided into 60-ft. lengths, and at each intersection 6-ft. strips of reinforcing fabric were laid transversely across the road 6 in. apart one on each side of the intended joint. The top layer of stone was then spread and rolled, and a 7x1-in. hardwood spacing board, cut to templet and well greased, was inserted into the stone in the space between the two strips of reinforcing fabric. The roller was then run over the joint to level off the displaced stone.

Next the road was penetrated with a 1-cement-2½-sand grout kept in a continuous agitation and poured through a hose. This grouting was done in alternate bays for the full width of the roadway, working from the highest point under construction and from the center of the road to the edges.

After grouting, the surface was rolled longitudinally by a 2-ton power roller, and ½-in. screenings were then spread evenly to a depth of about ¾ in. and rolled in, also with a power roller. The surface was then rolled transversely with a hand roller weighing about 2 cwt. and finished off with a rubber squeegee.

Until recently there has been one objection to the method as described—namely, that the surface was not nearly as good as that of the premixed road. This has now been overcome by the application of a plastic concrete surface. As carried out at Merewether, N. S. W., the grout was not brought completely to the surface, but the top of the stones was exposed to form a key. Immediately after grouting, a concrete of 1 sand, 2 cement and 3 clean 5/16-in. stone was mixed to a semi-dry consistency and rolled into the interstices of the stones, which had been left exposed. The rolling was accomplished with a 2-ton quick-reversing roller. Extra concrete was added where required, and the whole was screeded to shape and finished with a belt.

The finished thickness of this plastic top was 1 in. The semi-dry consistency of the concrete permitted any excess water that had been used in grouting to be absorbed, and thus the concrete surface was able to be finished in the usual way with a premixed concrete road. Expansion joints, using 2-in. Oregon fir, were provided at 50-ft. intervals during construction. The timber was kept 1 in. below the surface, and the concrete top was finished over the joint. The joint was allowed to take the crack that is normal in a concealed joint and was subsequently painted with bitumen. All corners and edges of the pavement were rounded to ½-in. radius.

Test Observations

While some may doubt the strength of cement penetration, considering its low cost, the results of experiments in quite a number of instances show that excellent results can be obtained. The Queensland Main Roads Commission in its work has obtained strengths approaching 3,000 lb. per sq. in. at 28 days, while a corresponding modulus of rupture of 652 lb. per sq. in. has been obtained in the laboratory. A more practical test was applied by W. J. Sunderland, engineer of Sandringham, in which a trench about 8 in. wide by 3 ft. long was made at the side of a cement-penetration road that was slightly undermined. A 6-in. stone cube was placed on the road at the side of the trench, and a 16-ton roller was driven over it. Two impacts were made, with the result that the second impact made a huge crack on the edge of the road. The piece of roadway was then broken off, and it was found that the fracture was a clean one running evenly through the cement and the stone.

(*Continued on page* 18)

[1] From July 28, 1932, issue of *Engineering News-Record* and reprinted through courtesy of that magazine.

« « EDITORIAL » »

A Highway and Building Congress

NO THOUGHTFUL observer of developments in the highway and building construction field and particularly with reference to highway construction can have failed to observe the effort which has been made during recent months to discredit in the public mind continued expenditure of funds for highway construction. We too often hear it stated, and unfortunately by those whose voice carries some weight, that our present highway system is entirely adequate for the demands made upon it and that governmental economy might well begin with a curtailment of funds for highway construction. This sentiment has even gone so far that in some localities it is becoming increasingly difficult to obtain authorization for highways sufficiently large to cover bare maintenance costs. At the same time, however, instead of witnessing a decrease in the taxation on motor vehicles and on gasoline consumption, we see such taxes increased and the revenues thus derived diverted to other purposes than the ones for which they were collected. That which should give us most serious concern is the readiness with which the man on the street is apparently accepting this philosophy, and to such an alarming degree. If coming events cast their shadows before, there is real significance in the sentiment developed during the sessions of state legislatures which have been held this year and we would be guilty of gross negligence if we fail to see the hand-writing on the wall. Fortunately but few of the state legislatures have been in session this year but in those that have we have witnessed to an unparalleled degree proposals for diverting gas tax revenues to general budget balancing purposes, the actual diversion of gas tax money for projects other than highway construction, the increase in gas tax rate accompanied by a decrease in the funds available for highway construction and exorbitant proposals for increasing taxation on motor vehicles.

There is no economic justification for such action. Highway transportation has made for itself a vital and necessary place in our national economic life. The earning power of billions of dollars invested in highways, streets and pavements, and motor vehicles must not be jeopardized by a judgment warped through unsound thinking stimulated by fear resulting from the present unfortunate economic situation.

Leaders in the highway construction industry have been very much aware of these recently unfavorable developments and it is commonly recognized that an intensive campaign of education must be engaged in in an effort to inform the taxpaying public of the true situation. With this thought in mind mutual agreement has been reached as between the leading organizations in the highway and building construction field to hold a highway and building congress in Detroit, Michigan, during the week of January 16, 1933. Under the plan decided upon, each of the participating organizations will hold simultaneous conventions in Detroit during the first three days of the week and will combine in a program for Thursday and Friday. Thursday will be devoted to the highway construction field and a program will be developed which will cover all economic phases of highway construction and maintenance. Friday will be devoted to building construction. This congress will mark an epoch in the construction industry. Never before has the opportunity been presented to hear such an array of speaking talent in one conclave. Outstanding leaders will discuss the basic problems underlying the continued success of this gigantic industry. It is essential that a rational program of highway construction and maintenance be continued even under present adverse conditions and it will be one of the primary objectives of this congress to give consideration to ways and means for best accomplishing this purpose.

The scope of the Congress is better realized from a review of the following organizations which have indicated their intention of participating.

Construction League of the United States
American Road Builders' Association
Associated General Contractors of America
Motor Truck Executives Association
The Asphalt Institute
National Paving Brick Association
National Ready Mixed Concrete Association
National Sand and Gravel Association
Portland Cement Association
National Crushed Stone Association

"Thou Shall Not Kill" [1]

UNRESTRAINED price-cutting is murder. Are you unwittingly a party to this crime? The price war now devastating the land is taking a heavier toll in human life, suffering, and morale than all the massacres of gangland. Prices cut below the live-and-let-live level must inevitably result in nation-wide disaster. This is the handwriting on the wall.

So long as buying power forces purchase price downward without regard to final consequences—respectable men will be out of gainful employment, innocent

[1] From the summer, 1932, issue of *Planoprinting* and reprinted through the courtesy of that magazine.

mothers will suffer, children will go hungry, and undernourished babies will be born into the world under physical handicap. Disease will ravage unchecked and even death will result. These are not intended as sensational, alarmist utterances; they are actual, present-day realities in prosperous, highly civilized Twentieth Century America.

The price-slasher, driving a hard bargain, is indirectly responsible for this deplorable condition. True, he is no Nero cruelly indifferent to the suffering of humanity—he does not intentionally profit by another's misfortune—but the result of his abuse of power is none the less disastrous for those who feel its dire consequences. A sin of ignorance it is—an evil to be corrected not by harsh denunciation, but by patient explanation of its wrongfulness; hence this preachment, "more in sorrow than in anger."

In America, we inherit the Yankee delight in shrewd bargaining, along with the Anglo-Saxon love for square-dealing. Temporarily the former has gotten the better of the latter. We plead for the return of fair-play and logic to business practice. Only in this way can the ever-tightening strangle-hold of unemployment, starvation, and misery be broken.

If, in the following paragraphs, we seem to use strong language, please bear in mind that we do so more to dissuade the reader from yielding to the temptation than to condemn those who have yielded. In the event that you have wielded the bludgeon to batter down price-resistance below the level of honest profit for the man or the concern from whom you are buying, you have more reason to pity yourself than we have to censure you.

During these hectic days, when fear and panic seem to have the upper hand and it is hard to trust one's own shadow—when nations go off the gold standard and financial kings lose their crowns—there seems at least to be one point upon which our government, legislative and executive, and our business structure, capital and labor, all agree: If we are to escape the dole, if we are to provide gainful occupation for the unemployed, if we are to lick the Depression—it is absolutely necessary that something like the normal price-levels of 1926 be restored.

Nevertheless, despite the fact that the seething political-industrial pot has boiled down to this one agreement, most persons in both groups are still heading in the opposite direction—wallowing deeper and deeper into the bottomless morass of under-bidding and under-selling. So long as we as individuals continue in this direction, the nation as a whole will suffer; times will get steadily worse. When individually we do an about-face to normalcy, collective prosperity will return.

Every time an individual or a concern temporarily benefits by a less-than-cost price on some commodity or service purchased, the country at large receives a setback. For each individual or concern that thus profits, many individuals and concerns suffer. Business firms fail; men are out of work; bread lines increase. Children go hungry to school; charity hospitals are crowded; community funds are depleted. Crime is rampant and anti-social tendencies grow. This is the geared-up, increased-destruction ratio of price-cutting when practiced on a national scale. Multiply any one instance by hundred-thousands duplicated daily and we have the destructive force now undermining the very foundation of our economic structure.

We are not concerned so much with the unscrupulous buyer, the bargain bully, the peacetime profiteer who uses his money-power to force the purchase price below cost; or with the cringing seller who will ignominiously stoop to any level to get an order. These undesirables are the small minority, and soon pass out of the picture, victims of their own shady practices.

What concerns us most is the great mass of buyers who, drunk with bargain power, are unknowingly wreaking misery on their fellow men by their collective activities. Thoughtless, almost universal price-slashing is directly responsible for the abject misery visited upon the unemployed today, be they the humblest day-laborers, the white-collar employees, the ousted corporation heads, or the veterans who trekked across the continent to seek relief in Washington.

If by the common, oft-repeated threat, "The lowest price gets the job," you or any other buyers force the price blindly down below the honest profit to which the producer is entitled, you are surely, if unintentionally, lowering the standard of living—for others, for yourself. When the lowest price gets the job, without regard to cost or consequences, the income of every man in a specific industry is jeopardized; purchasing power is curtailed; credit is tightened. If *you* are a price-cutter, *you* are destroying the confidence and capital to provide gainful and decent employment for those who are striving valorously to retain their self-respect and good citizenship—*in short, you are a public enemy.*

From a selfish standpoint alone, you are hurting yourself more than others; for misuse of buying power to encourage, force, or even permit pricing below cost, must in the end destroy the very income of the individual who abuses that power—so dependent is the welfare of one industry upon that of another.

Of course, it goes without saying that prices should be lower than the 1929 peak. Reduced commodity prices, lowered overhead, readjusted wage and salary scales, improved production and marketing methods—all these changes that have come to industry within the past three years have made possible certain savings to which you are justly entitled. But, there is a danger line below which the price gauge must not sink, if the business ship of state is to stay afloat.

Our plea is that the purchase be made at the *right* price, rather than the lowest price; and the right price

is very easily determined. While few prices are completely standardized, production methods and cost systems *are* standardized. The modern manufacturer today knows his costs as accurately in one industry as in another, and dependable manufacturers—the only ones with whom you should deal—are usually unhesitant in laying down their costs to their customers.

When *you* ask for an estimate, make it plain that you want a reasonable price, but that at the same time you expect the seller to make a fair profit. Such an expression of frankness may startle him, but you will certainly get a price that is right; and what is better, you will have gone a long way toward reestablishing the confidence that will avert this economic crisis and bring back prosperity.

But we all agree it is the seller as much as the buyer who is responsible for the deplorable price war now sapping the vitality of industry.

If *you*, as a member of this group, have cut your prices to the bleeding point in order to get your assumed share of the business even at a loss, *you have invited commercial suicide*. He who lowers his prices below the level of logic and sanity must invariably seek self-preservation by forcing every one from whom he buys to come down likewise. That is the damnable part of this vicious circle of price-cutting. One individual or firm cannot force its own prices below a fair profit without forcing every other line of industry with which it is allied, to do the same.

You know your costs. You know exactly what profit you must have to live and let live. You can put your cards on the table, too. Insist on your rights as an honest member of an honored craft. People will respect you for it and will reward you by giving you their business. This is the inevitable action that you, we, and everybody else in the world of business must take if normalcy is to come back. It must be done as promptly as possible. *It's a rush job.*

Cement-Penetration Road Practice In Australia

(*Continued from page* 15)

In the consideration of the system two questions are invariably asked: (1) Does the grout penetrate completely through the metal? and (2) How do the strengths that are obtained from concrete manufactured by grouting conform to the now generally accepted water-cement-ratio theory of the manufacture of concrete?

Of the many specimens that have been cut for inspection purposes from the increasingly large number of roads being constructed no specimen has yet been cut that has shown an imperfectly grouted road. Thus it can be taken as axiomatic that, given the right consistency—and this is simple of determination with any sand and cement used—penetration is complete.

In answering the second question one must consider primarily the conditions under which ordinary concrete is placed. Under average conditions the full amount of mixing water that is used with concrete is retained within the mass of the concrete, and the strength of the concrete thus obtained will be in direct relationship to the ratio of water to cement, provided the mixture is plastic and workable.

In the construction of a road by grouting system a porous foundation is usually supplied where none exists. Thus it is possible, and actually does happen, that the apparently excess water necessary to obtain the desired consistency that will permit the penetration of the grout becomes absorbed, leaving the water-cement ratio actually in the concrete thus manufactured very much less than that which was originally used in the grout.

Another reason for the high strengths obtained is that, subsequent to grouting operations, the whole mass of stone and grout is vibrated by the action of a 2-ton roller. This vibration of the stone insures that the grout will completely penetrate the voids.

Confirmation of the fact that strength is due to a combination of these conditions may be obtained when a section of the road is cut after completion of the manipulative processes, and a specimen is crushed and compared with the strength obtained from a molded specimen, with the same grout and same metal in a mold that is completely water-tight. Many comparative tests made in this fashion show that the strengths obtained on the sections cut from the road are 50 per cent greater.

Two factors appear to be necessary for the success of a cement-penetration job: the prime factor is that the stone to be penetrated should be comparatively coarse; second, the grout should be mixed in such a manner and in such a type of mixer that it will insure a constant uninterrupted flow of the desired consistency, and this consistency should be maintained constantly throughout the operations; thirdly, the consistency of the grout should be such that segregation of the materials cannot take place. It is important that the mixer shall be of such a type that the grout is kept in constant agitation to the period of its entering into the road. Attention to this will assure the impossibility of segregation of sand and cement.

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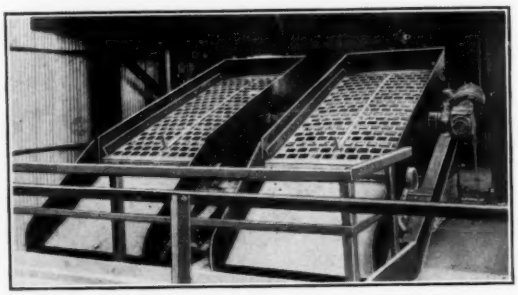

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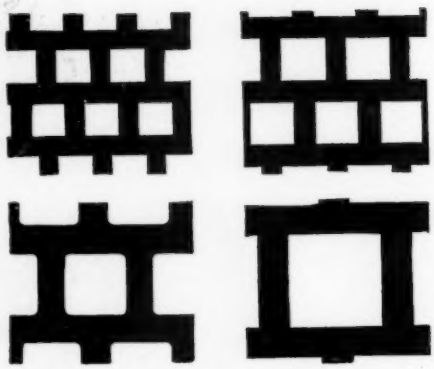

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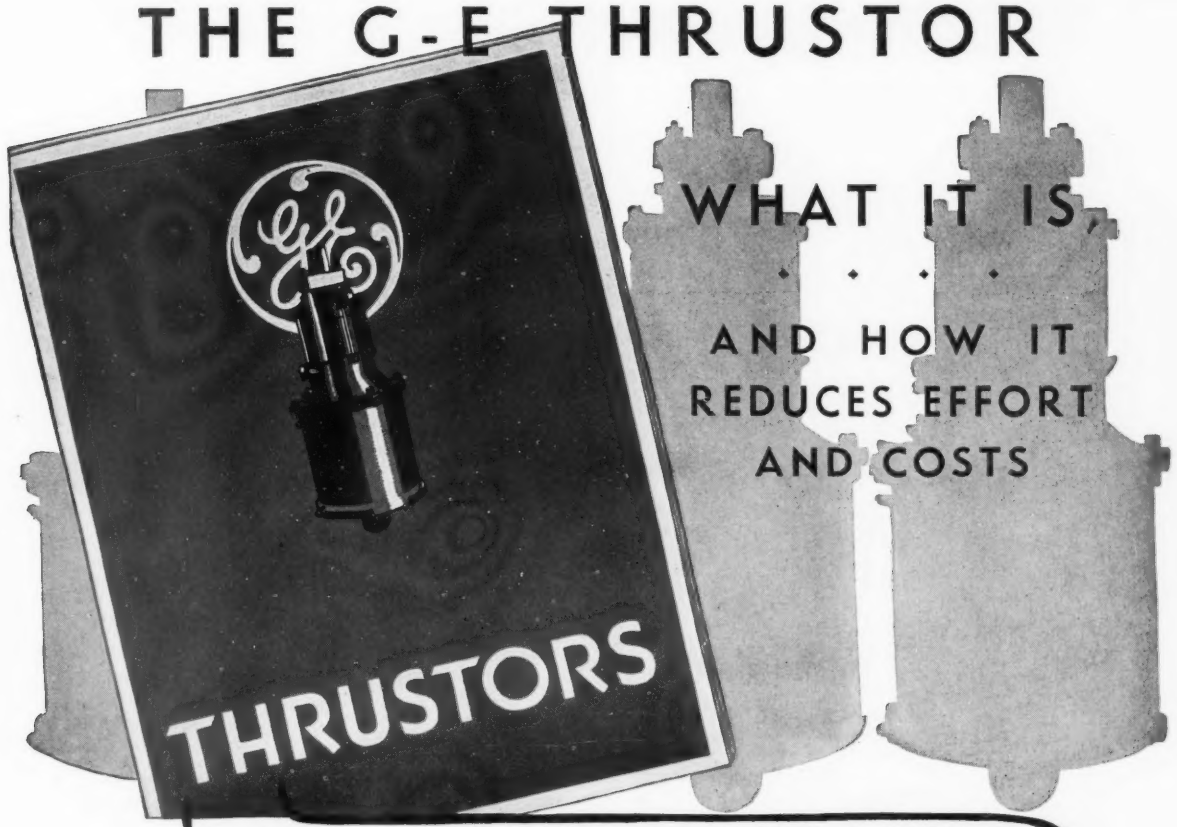

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The National Crushed Stone Association will participate in this Congress by holding its Sixteenth Annual Convention at the Book-Cadillac Hotel, Detroit, Michigan, January 16, 17 and 18. On Thursday and Friday, January 19 and 20 all groups present at the Congress will combine in a joint program devoted on Thursday to Highways, and on Friday to Building.

The Manufacturers Division Exposition will be held in the Book-Cadillac Hotel jointly with the Exposition of the National Sand and Gravel Association whose convention will be held independently but simultaneously with ours and in the same hotel.

This arrangement as regards both the Congress and the joint Exposition offers many obvious economies to delegates and exhibitors alike.

All crushed stone producers of the United States and Canada, regardless of whether or not they are members of this Association, are most cordially invited to be present and take part in our forthcoming annual convention and this unprecedented mobilization of the construction industry.

FOR FURTHER INFORMATION ADDRESS

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